The Constellation-X Observer

http://constellation.gsfc.nasa.gov Volume 1, Winter 2007

Opening the Window of X-ray Spectroscopy – Tracing the Energetics of the Universe

Mission Updates

Welcome to the first edition of the Constellation-X Observer. The Observer will provide information about the current state of the mission, including recent progress on instrumentation and other items of interest such as the Constellation-X science updates for the Decadal Survey. Each issue will also contain a "Focus On" section that highlights Constellation-X science, paired with powerpoint slides which we hope you may find suitable for inclusion in your next talk on this science. If you have material appropriate for a "Focus On" section, please contact the editors at conx-observer@lists.nasa.gov.

The Mission Specifications have been changed to (1) enlarge the field of view of the XMS from 2.5′ to 5′ on a side, and (2) increase the minimum resolving power from 300 to 1250 between 0.3-1 keV. The first change was implemented to improve the efficiency of cluster observations by up to a factor of four as the need to raster will be reduced for most clusters, while the second change will improve measurements of the WHIM, stellar coronae, and warm absorbers in AGN.

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Technology Development Update

The Transition Edge Sensor (TES) team has had a number of recent successes. Breakthrough energy resolution has been achieved with sensors employing electroplated all-gold and gold/bismuth X-ray absorbers. Resolutions at 6 keV for 13 pixels with Au absorbers have ranged from 2.3 to 3.1 eV, while resolution as good as 2.1 eV at 6 keV has been measured in a single pixel with a Au/Bi absorber.

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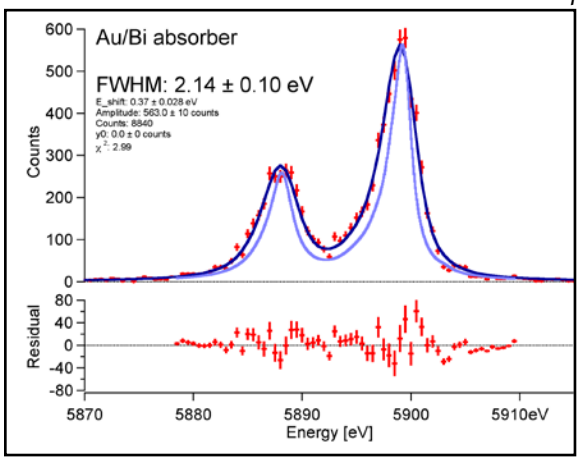

Spectrum of ^{55}Fe source observed with TES calorimeter with an Au/Bi absorber; light blue shows the natural line width.

Focus On: Cosmic Feedback

Numerical simulations of the formation of large scale structure and galaxy formation over-produce the most massive galaxies in the Universe. Unless the simulations dramatically miss the mark, a source of energy that arrests star formation is needed. At present the best explanation for these effects is the 'feedback' between the central black hole and its host galaxy such that they co-evolve (Hopkins et al. 2006). Starburst winds are believed to create similar effects on lower mass galaxies. Many theoretical simulations now use AGN feedback as a knob that is turned to produce the correct number of massive galaxies, but the physics of the mechanism is poorly constrained. Various possibilities include mechanical winds from the central AGN, radiation (see Ostriker and Ciotti 2006) and relativistic particles (jets). These same processes may also solve the riddle of cooling flows in galaxies, clusters and groups, and determine why cluster scaling relations differ from those predicted by dark-matter-only models.

To determine what is actually occurring, the energy injection must be directly measured, requiring X-ray observations that only Constellation-X can provide. With spatially-resolved high spectral resolution detectors, Con-X will determine the effects of the AGN on surrounding gas (e.g. groups and clusters), determine (as a function of redshift) the energy input from star

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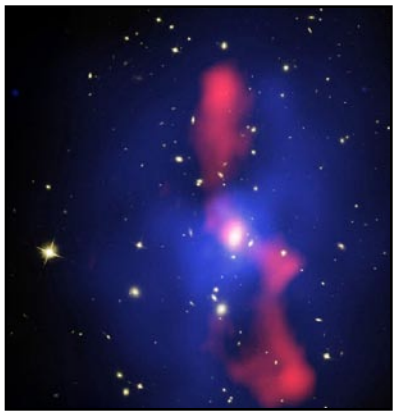


A composite image (white HST, blue Chandra, red VLA) shows the galaxy cluster MS0735.6+7421 (z=0.2). Enormous cavities in the X-ray gas, each 200 kpc in diameter, are filled with radio emission. It is believed this structure is created by jets, but the lack of spatially-resolved high spectral resolution detectors prevents detailed charaterization of the kinematics of the hot X-ray gas.

Mission Updates (con't)

The next Constellation-X facility science team (FST) meeting will be held February 21-22, 2008 in Boulder, Colorado. FST meetings are always open to anyone interested in the mission; more information can be found on the Constellation-X website. The meeting will focus on preparations for the upcoming decadal survey, including a review of recent progress in instrumentation and reports from the newly restructured science panels (see next).

The Constellation-X Science panels have been updated to refine the mission science case. The panels cover the following topics:

Panel Topic	Chair
Missing Baryons/WHIM; synergy with UV spectroscopy	Mike Shull
Extreme States of Matter in Neutron Stars	Frits Paerels
Accretion Physics in Stellar Systems	Jon Miller
Census of Black Hole Accretion in the Universe	Nancy Levenson
Evolution of Large Scale Structure in the Universe	Steve Allen
Hot Baryons in Deep Potential Wells	Christine Jones
Testing General Relativity and Measuring Black Hole Spin	Chris Reynolds
Supernova/Stellar Feedback	David Strickland
Production and Distribution of the Elements	John P. Hughes
AGN Feedback: Outflows & Jets	Andy Fabian
MHD Physics in Stellar Environments	Rachel Osten
The high-z Universe, Re-ionization & Synergy with JWST "First Light" Science	Niel Brandt
Solar System, Planet Formation & Evolution	Eric Feigelson
Plasma Diagnostics and Atomic Astrophysics	Nancy Brickhouse

We welcome your input to these panels, either by email to conx-observer@lists.nasa.gov, attendance at the FST meetings, or by contacting the chairs of the panels directly. More information is available at the Constellation-X home page.

Focus On: Cosmic Feedback (con't)

formation (e.g. superwinds), and observe the IGM and determine its metallicity as a function of redshift. Constellation-X can obtain the needed measurements and provide us with a proper understanding of how structure in the Universe forms and evolves.

More information about this topic, along with prepared powerpoint slides, is available at **http://constellation.gsfc.nasa.gov/FocusOn/**

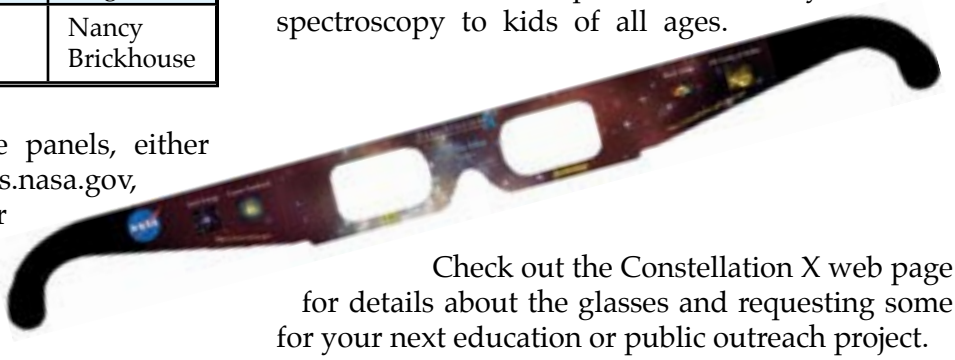
Instrumentation Update (con't)

This result with the Au/Bi absorber improves to 1.8 eV with data screening based on the temperature of the TES prior to X-ray absorption. These results have been enabled by cantilevered absorbers that make contact to the TES only in regions that are not part of the active thermometer. With this approach, the X-ray energy thermalizes rapidly after absorption and interaction between the absorber and TES sensor films is avoided.

This design enables a uniform high performance and is compatible with large-format, high fill-factor arrays. In addition to meeting the Constellation-X XMS requirements for spectral resolution, such calorimeter arrays fabricated at NASA/Goddard have demonstrated the ability to meet requirements for quantum efficiency and pixel size in a close-packed geometry.

The electronics for reading out the XMS focal plane array have also progressed considerably. Superconducting multiplexers developed and implemented at NIST – Boulder can now read 128 TES pixels with 4 SQUID amplifiers. This N x 32 multiplexing is the same scale needed for the XMS, although the system bandwidth is currently about a factor of four lower than will ultimately be achieved by the flight electronics.

Coming soon: The return of the ever-popular Constellation-X glasses! We have ordered another batch of these amazing glasses, which contain prisms that demonstrate the power and beauty of spectroscopy to kids of all ages.



Check out the Constellation X web page for details about the glasses and requesting some for your next education or public outreach project.